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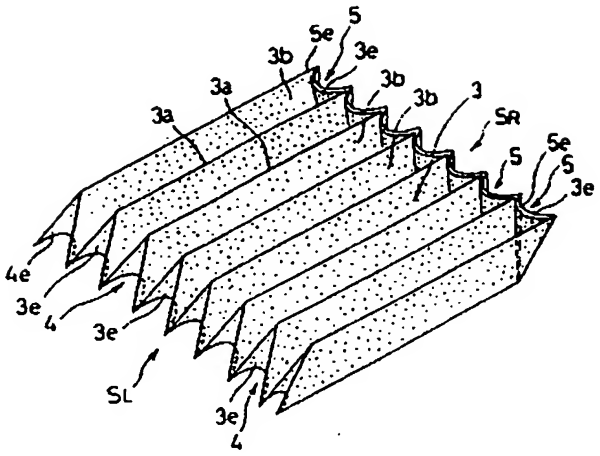
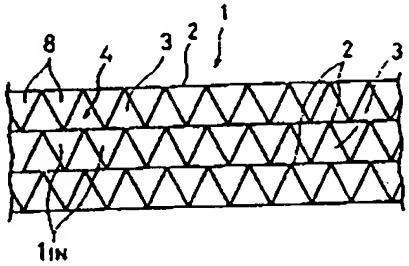
APPLICANT : TOYO ROKI SEIZO KK;

INVENTOR : KADOYA TERUKAZU;

INT.CL. : B01D 46/00 B01D 29/06

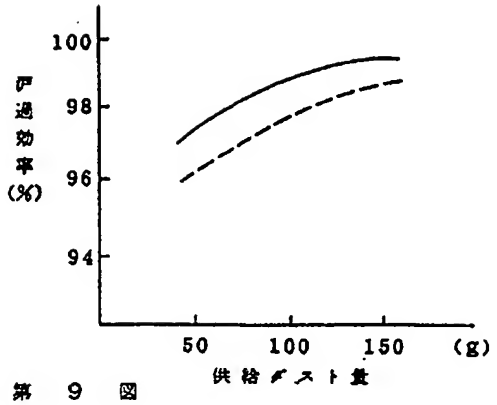
TITLE : FILTER ELEMENT



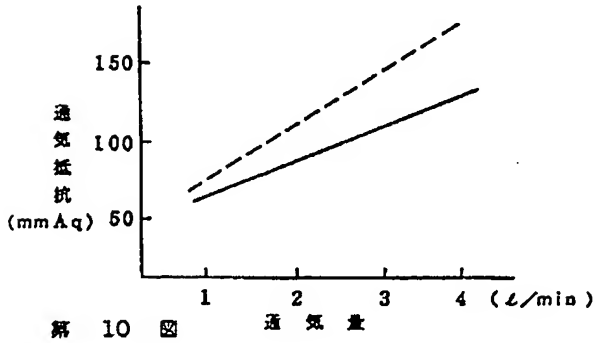




ABSTRACT : PURPOSE: To obtain an increased filtration area of a filter element by folding each crest part of a corrugated filter medium at a side end part of the medium in such a manner that the crest part may contact closely to each adjacent flat filter medium, closing an end part of each crest part by the folded part, folding similarly each valley part adjacent to each crest part at another side end of the filter medium in the same manner and closing an end of each valley part by the folded part.

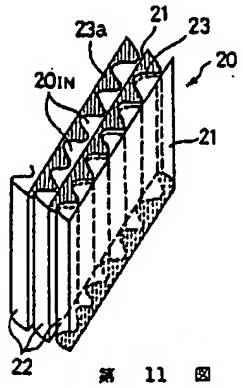
CONSTITUTION: A filter element 1 is constituted of a sheet shaped flat filter medium 2 and a corrugated filter medium 3. In this case, each crest part 3a of the corrugated filter medium 3 is folded at a side end SL of the corrugated filter medium 3 in such a manner that each crest part 3a may closely contact each flat filter medium 2, and the end part 3e of each crest part 3a is closed by the folded part 4. Further, each valley part 3b is folded at the other side end SR of the corrugated filter medium 3 in such a manner that each valley part may closely contact each flat filter medium 2, and the end part 3e of each crest part 3b is closed by the folded part 5. As a result, both end parts SL and SR of the corrugated filter medium 3 are used effectively as filtration area, the ventilation resistance is reduced, and an increased filtration area is obtd.



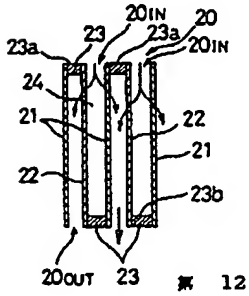

第 9 図



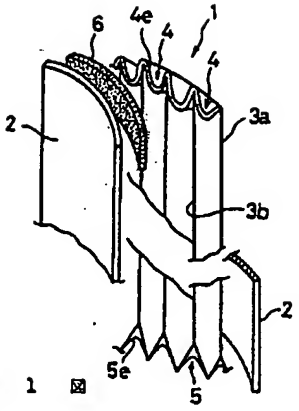

第 10 図



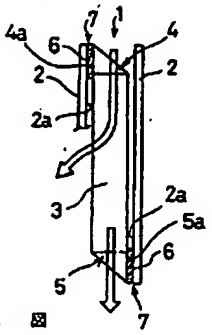

第 11 図



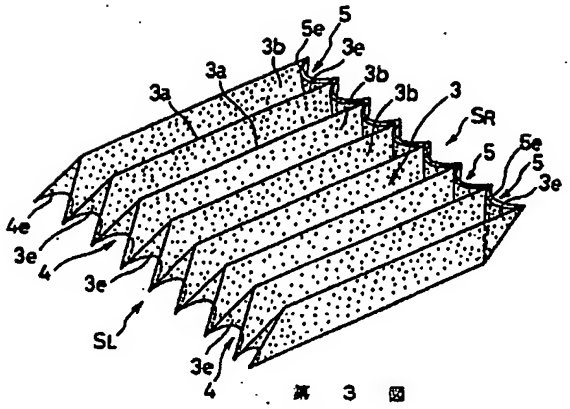

第 12 図



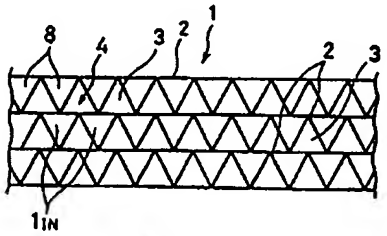

第 1 図



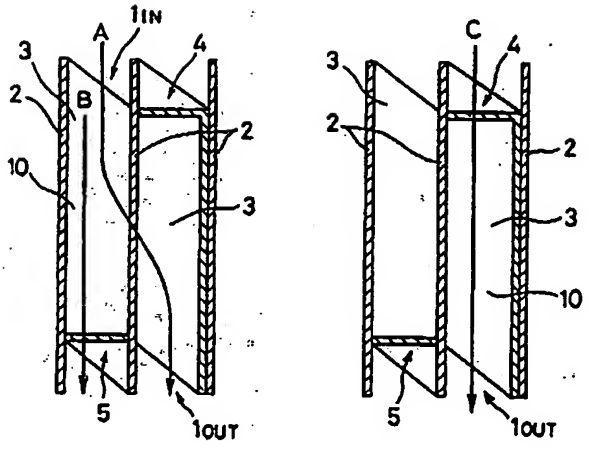

第 2 図




第 3 図

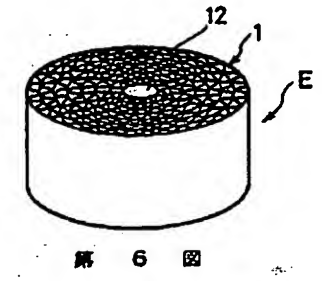



第 4 図

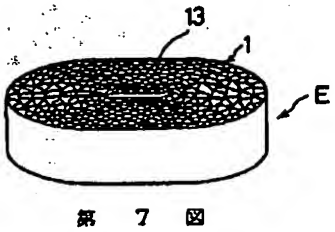



( a ) ( b )

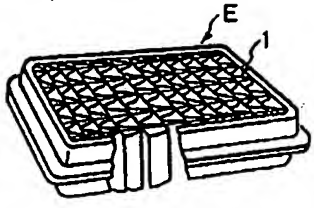
第 5 図




第 6 図




第 7 図




第 8 図

／minである。

第９図は、供給ダスト量（ｇ）に対する沪過効率（％）の変化を示したものであり、同図において、横軸が供給ダスト量（ｇ）、縦軸が沪過効率（％）であり、破線が従来のフィルタエレメントを示し、実線が本発明のフィルタエレメントを示したものである。第９図で明らかなように、沪過効率は、本発明のフィルタエレメントが従来のものに比べて１％以上上昇している。

また、第１０図は、エアの通気量（ℓ／min）に対する通気抵抗（mmAq）の変化を示したものであり、同図において、横軸がエア通気量（ℓ／min）、縦軸が通気抵抗（mmAq）であり、破線が従来のフィルタエレメントを示し、実線が本発明のフィルタエレメントを示したものである。第１０図で明らかなように、通気抵抗は本発明のフィルタエレメントが従来のものに比べて飛躍的に減少している。

〔発明の効果〕

以上、実施例の説明から明らかなように、本発明は、シート状の平板沪材と、多数の山部と谷部を連設して波形状に形成した波形沪材とからなるフィルタエレメントにおいて、波形沪材の一開端にて各山部をそれぞれ隣接する平板沪材に密接可能に折曲した折曲部にて各山部の端部を閉塞するとともに、他開端にて上記各山部に隣接する各谷部をそれぞれ隣接する平板沪材に密接可能に折曲した折曲部にて各谷部の端部を閉塞できるため、上記各山部、谷部の両端部を接着剤等の充填シール材にて閉塞する必要がなく、この両端部を沪過面として活用することができる。したがって、本発明のフィルタエレメントは沪過面積を大きくとることができ、これにより沪過性能の向上を図ることができるとともに、沪材単位面積当り捕集するダスト量は一定であるため沪過面積が多くとれた分だけエレメントのロングライフ化が可能となる。

また、本発明においては、沪過流量が同一の比較においては、沪過面積が多い分だけエレメントを通過する流速がゆるやかになり、その結果沪過効率の上昇につながる。

さらに本発明によれば、エレメントの各山部、谷部の両端部を充填シール材にて閉塞されていないため、被沪過流体がエレメントに流入する際及びクリーンサイドに流出する際の通気抵抗の低減を図ることができる。

４．図面の簡単な説明

第１図は本発明に係るフィルタエレメントの斜視図、第２図はフィルタエレメントの断面図、第３図はフィルタエレメントの波形沪材の斜視図、第４図はフィルタエレメントの平面図、第５図はフィルタエレメントの作用説明図、第６図乃至第８図は本発明に係るフィルタエレメントを応用したエレメントの斜視図、第９図及び第１０図は従来のフィルタエレメントと本発明のフィルタエレメントについての沪過性能の比較試験結果を示す図、第１１図は従来のフィルタエレメントの斜視図、第１２図はその作用説明図である。

１…フィルタエレメント、２…平板沪材、３…波形沪材、４…折曲部、５…折曲部、６…接着剤、７…封着部、８…個室、１０…流路。

出願人代理人　石　川　泰　男

いて、波形沪材３と相隣接する平板沪材２，２とは接着剤６により接合されることにより封着部７が形成される。この封着部７は、波形沪材３の折曲部４，５の端面４ｅ，５ｅと平板沪材２の対向面２ａとが密着することにより形成される。

しかして、上述のようにフィルタエレメント１を形成して積層することにより、第４図にその平面図が示されるようにエレメントの断面がハニカム状となり、あたかも個室８を有するようになる。

次に、前述のように構成された本発明に係るフィルタエレメントの作用について説明する。

第４図及び第５図において、被沪過流体であるエアは第５図（ａ）の矢印Ａで示されるように平板沪材２と波形沪材３とにより形成される略三角形状の多数の流入側開口端$1_{IN}$よりエメレント内に流入し、平板沪材２と波形沪材３との間に形成された流路１０内を進み、平板沪材２又は波形沪材３の沪過面を通過する間に沪過されて流出側開口端$1_{OUT}$より流出する（ここでは平板沪材２を通過するものしか示さず）。また、被沪過流体であるエアは矢印Ｂで示されるように流路１０内を直進して折曲部５を通過して沪過される。

また、流入側開口端$1_{IN}$からエレメント内に被沪過流体が流入しないで、第５図（ｂ）矢印Ｃで示されるようにエレメントへの流入側にある折曲部４を直接通過して沪過された後エレメント内に流入し、流路１０内を直進して流出側開口端$1_{OUT}$より流出する。

このように、本発明のフィルタエレメントによれば、波形沪材３の一側端にて各山部３ａをそれぞれ隣接する平板沪材２に密接可能に折曲した折曲部４と、他側端にて上記各山部３ａに隣接する各谷部３ｂをそれぞれ隣接する平板沪材に密接可能に折曲した折曲部５とを形成したため、この折曲部４，５が沪過面を構成し、通気抵抗の減少及び沪過面積の拡大を図ることができる。なお、折曲部４，５の折曲深さをエレメント内方に深くすれば沪過面積は更に増大する。また、第４図に示すようにフィルタエレメント３の断面がハニカム状となり、このように断面ハニカムを形成すると、沪材部が個室８を有するようになり、この個室８の長所は沪紙表面に付着したダストが流体の影響を受け移動することを防ぐ。ダストが移動すると、ダスト自体により形成されたケーキ層ができにくくライフが短くなるが、これを防ぐことによりロングライフ化が可能となる。

なお、実施例の説明では折曲部４，５は半円形状としたが、相隣接する平板沪材２，２に密接するものであれば他の形状でも勿論良い。

次に、第１図乃至第５図のように構成した本発明に係るフィルタエレメント１を巻成または積層することにより形成した渦巻き型エレメント、長円型エレメント及び積層型エメレントの例を説明する。

第６図の渦巻き型エレメントＥは、１枚の平板沪材２と折込み部４，５を有した１枚の波形沪材３とを重ね合わせ、円筒状の軸心１２の周囲に波形沪材３を内側にして渦巻き状に巻き、折曲部４，５の箇処において、波形沪材３と相隣接する平板沪材２，２とが接着剤６により接合することにより構成される。

第７図の長円型エレメントＥは、１枚の平板沪材２と折曲部４，５を有した１枚の波形沪材３とを重ね合わせ、長円筒状の軸心１３の周囲に波形沪材３を内側にして長円形状に巻き、折曲部４，５の箇処において、波形沪材３と相隣接する平板沪材２，２とが接着剤６により接合することにより構成される。

第８図の積層型エレメントＥは、１枚の平板沪材２と折曲部４，５を有した１枚の波形沪材３とを交互に積層し、折曲部４，５の箇処において、波形沪材３と相隣接する平板沪材２，２とが接着剤６により接合することにより構成される。

〔実験結果〕

次に、本発明に係るフィルタエレメントの実験結果を従来のフィルタエレメントとの比較において説明する。

このとき、使用したダストはＪＩＳＺ８９０１の８種であり、テスト方法はＪＩＳＤ１６１２に準じて行った。試験空気量は６．５

第１１図及び第１２図に示されるように平板沪材２１と、ひだ折りし山部と谷部とを形成した波板沪材２２とを交互に重ね合せ、一側端の波形沪材２２の山部と他側端の波形沪材２２の谷部とを充填シール材２３により充填シールし、両側端間に一端が開放し、他端が閉塞する多数の流路を形成したものである。そして、このハニカム型フィルタエレメント２０においては、被沪過流体であるエアは矢印で示すように入口側開口端$20_{IN}$よりエレメント内に流入し、平板沪材２１と波形沪材２２との間に形成された流路２４内を通み、エレメントの沪過面を通過する間に清浄にされ、出口側開放端$20_{OUT}$より流出する。

〔発明が解決しようとする問題点〕

しかしながら、上述した従来のハニカム型エアフィルタにおいては、被沪過流体がエレメントに流入する際に被沪過流体の一部が第１２図に示されるように充填材２３の外端面２３ａに衝接し、通気抵抗が増大するという問題点がある。この問題は、クリーンサイドへ被沪過流体が流出する際にも生ずる。即ち、被沪過流体が充填シール材２３の内端面２３ｂに衝接し、通気抵抗が増大するという問題点がある。

また、上述の問題点を沪過面積の点から考慮すれば、充填シール材２３により閉塞されている部分は沪過面としては活用できないため、沪過面積の減少になり、ひいてはロングライフ化の妨げとなっているという問題点がある。

本発明は上記事情に鑑みて創案されたもので、その目的とする処は、被沪過流体の通気抵抗の低減を図るとともに沪過面積の増大を図ることにより、沪過性能の向上を達成するとともに長期間にわたって良好な沪過性能を維持し続けることができるフィルタエレメントを提供することにある。

〔問題点を解決するための手段〕

上記問題点を解決するために本発明は、シート状の平板沪材と、シート状の沪材を折曲して多数の山部と谷部を連設して波形状に形成した波形沪材とを交互に配置したフィルタエレメントにおいて、上記波形沪材の一側端にて各山部をそれぞれ隣接する平板沪材に密接可能に折曲し、この折曲部にて各山部の端部を閉塞し、他側端にて上記各山部に隣接する各谷部をそれぞれ隣接する平板沪材に密接可能に折曲し、この折曲部にて各谷部の端部を閉塞したことを特徴とするものである。

〔作用〕

本発明は上記手段により、シート状の平板沪材と、多数の山部と谷部を連設して波形状に形成した波形沪材とからなるフィルタエレメントにおいて、波形沪材の一側端にて各山部をそれぞれ平板沪材に密接可能に折曲した折曲部にて各山部の端部を閉塞するとともに、他側端にて上記各山部に隣接する各谷部をそれぞれ平板沪材に密接可能に折曲した折曲部にて各谷部の端部を閉塞できるため、上記各山部、谷部の両端部を接着剤等の充填シール材にて閉塞する必要がなく、この両端部を沪過面として活用することができ、通気抵抗の減少及び沪過面積の増大を図ることができる。

〔実施例〕

以下、本発明に係るフィルタエレメントの実施例を第１図乃至第５図を参照して説明する。

本発明に係るフィルタエレメント１は、第１図及び第２図に示されるようにシート状の平板沪材２と、シート状の沪材を折り曲げて多数の山部３ａと谷部３ｂとを連設して波形状に形成した波形沪材３とを重ね合わせ、これら平板沪材２と波形沪材３とを交互に配置したものからなっている。

上記波形沪材３は、第３図に示されるようにその一側端$S_L$において各山部３ａの端部３ｅをそれぞれ隣接する平板沪材２に密接可能に折曲して折曲部４を形成し、この折曲部４にて各山部３ａの端部３ｅを閉塞し、又、他側端$S_R$において各谷部３ｂの端部３ｅをそれぞれ隣接する平板沪材２に密接可能に折曲して折曲部５を形成し、この折曲部部５にて各谷部３ｂの端部３ｅを閉塞する。これにより、折曲部４と折曲部５とは互いに相反する方向に折込まれることになり、折曲部４，５の端面４ｅ，５ｅは略半円形をなすように内方に折曲されることになる。そして、第１図及び第２図に示されるように上記折曲部４，５の箇処にお

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　平1-171615

| ⑤Int.Cl.⁴ | 識別記号 | 庁内整理番号 | ⑬公開　平成1年(1989)7月6日 |
|---|---|---|---|
| B 01 D 46/00<br>29/06 | 302 | 6703-4D<br>B-2126-4D<br>A-2126-4D | 審査請求　未請求　発明の数 1　(全6頁) |

⑤④発明の名称　フィルタエレメント

⑳特　願　昭62-327470
㉒出　願　昭62(1987)12月25日

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㉔代理人　弁理士 石川　泰男　外2名

明　細　書

1．発明の名称

フィルタエレメント

2．特許請求の範囲

1．シート状の平板沪材と、シート状の沪材を折曲して多数の山部と谷部を連設して波形状に形成した波形沪材とを交互に配置したフィルタエレメントにおいて、上記波形沪材の一側端にて各山部をそれぞれ隣接する平板沪材に密接可能に折曲し、この折曲部にて各山部の端部を閉塞し、他側端にて上記各山部に隣接する各谷部をそれぞれ隣接する平板沪材に密接可能に折曲し、この折曲部にて各谷部の端部を閉塞したことを特徴とするフィルタエレメント。

2．上記折曲部は、折曲部端面が略半円形をなすように内方に折曲されることを特徴とする特許請求の範囲第1項記載のフィルタエレメント。

3．発明の詳細な説明

〔産業上の利用分野〕

本発明はフィルタエレメントに係り、特に内燃機関のエアークリーナに使用されるフィルタエレメントに関する。

〔従来の技術〕

内燃機関等のエアークリーナに使用されるエレメントには、乾式タイプと湿式タイプがあることは一般的に知られている。いずれの場合も沪過方法としては表面沪過、深層沪過がその主流を占めている。斯かるエアークリーナエレメントとして要求される条件としては被沪過流体中に存在するダストなどの微粒子を効果的に除去する沪過性能を有し、しかも長期間にわたって良好な沪過性能を維持し続けることが重要である。

このような観点から、従来から種々のエレメントが提供されており、例えば、実開昭61-200116号公報に記載のハニカム型エアフィルタがある。

斯かるハニカム型フィルタエレメント20は、

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# FILTER ELEMENT

| | |
|---|---|
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[There are no amendments to this patent.]

Claims

1. A type of filter element characterized by the following facts: the filter element has sheet-shaped flat filter members and corrugated filter members, each of which corrugated members is prepared by folding a sheet-shaped filter member to form plural crest portions and trough portions, set alternately; on one side edge of said corrugated filter members, each corrugated filter member is folded such that its crest portions are in close contact with the

adjacent flat filter member; by means of this folding portion, the end portion of each crest portion is closed; on the other side edge, each corrugated filter member is folded such that the trough portions are in close contact with the adjacent flat filter member; by means of this folding portion, the end portion of each trough portion is closed.

2. The filter element described in Claim 1 characterized by the fact that each said folding portion is formed by folding inward so that the end surface of the folding portion becomes nearly semi-circular.

Detailed explanation of the invention

Industrial application field

This invention pertains to a type of filter element. Especially, this invention pertains to a type of filter element for use in the air cleaners of internal combustion engines.

Prior art

It is well known that elements for use in the air cleaners of internal combustion engines include a dry type and a wet type. For both types, the major filtering schemes include surface filtering and deep-layer filtering. Such air cleaner elements are required to have a filtering property for effectively removing dust or other fine particles, and to be able to maintain good filtering performance over a long period of time.

From this viewpoint, various types of elements have been developed, such as a honeycomb shaped air filter described in Japanese Kokai Utility Model No. Sho 61[1986]-200116.

Said honeycomb shaped filter element (20) has the following constitution shown in Figures 11 and 12. Flat filter members (21) and corrugated filter members (22), each of which is prepared by folding to form crest portions and trough portions, are overlapped alternately. The crest portions of corrugated filter members (22) on one side edge and the trough portions of corrugated filter members (22) on the other side edge are sealed with filling of filling sealant (23), so as to form plural flow channels, each of which has one end opened and the other end closed, between the two side edges. For said honeycomb shaped filter element (20), air as the fluid to be filtered flows through inlet ($20_{IN}$) indicated by the arrow into the element. Air moves within flow channels (24) formed between flat filter members (21) and corrugated filter members (22), and becomes clean as it permeates through the filtering planes of the element. The filtered air then flows out from outlet ($20_{OUT}$).

Problems to be solved by the invention

The aforementioned conventional honeycomb shaped air filter has some problems. As the fluid to be filtered flows into the element, as shown in Figure 12, a portion of the fluid to be filtered collides with outer end surface (23a) of filler (23), so that the air passage resistance increases. This problem also takes place when the filtered fluid flows out the clean side. That is, the filtered fluid collides with inner end surface (23b) of filling sealant (23), leading to an increase in the air passage resistance.

With regard to the filtering area, due to the aforementioned problem, the portion closed with filling sealant (23) cannot be used as a filtering plane. Consequently, the filtering area decreases, and, finally, it is hard to realize a long lifetime. This is undesired.

The objective of this invention is to solve the aforementioned problems of conventional methods by providing a type of filter element characterized by the fact that by reducing the air passage resistance of the fluid to be filtered and increasing the filtering area, it is possible to improve the filtering performance, and, at the same time, to maintain good filtering performance over a long period of time.

Means to solve the problems

In order to realize the aforementioned objective, this invention provides a type of filter element characterized by the following facts: the filter element has sheet-shaped flat filter members and corrugated filter members, each of which corrugated members is prepared by folding a sheet-shaped filter member to form plural crest portions and trough portions, set alternately; on one side edge of said corrugated filter members, each corrugated filter member is folded such that its crest portions are in close contact with the adjacent flat filter member; by means of this folding portion, the end portion of each crest portion is closed; on the other side edge, each corrugated filter member is folded such that the trough portions are in close contact with the adjacent flat filter member; by means of this folding portion, the end portion of each trough portion is closed.

Operation of the invention

According to this invention, with the aforementioned means, in a filter element composed of sheet-shaped flat filter members and corrugated filter members, each of which is prepared by folding a sheet-shaped filter member to form plural crest portions and trough portions, set alternately; on one side edge of said corrugated filter members, each corrugated filter member is folded such that its crest portions are in close contact with the adjacent flat filter member; by means of this folding portion, the end portion of each crest portion is closed; on the other side edge, each corrugated filter member is folded such that the trough portions are in close contact

with the adjacent flat filter member; by means of this folding portion, the end portion of each trough portion is closed. Consequently, there is no need to use a filling sealant to close the two end portions for each of said crest portions and trough portions. As a result, said two end portions also can be used as filtering planes. Consequently, it is possible to reduce the air passage resistance and to increase the filtering area.

Application examples

In the following, application examples of the filter element of this invention will be explained with reference to Figures 1-5.

As shown in Figures 1 and 2, for the filter element 1 of this invention, sheet-shaped flat filter members (2) and corrugated filter members (3), each of which is prepared by folding a sheet-shaped filter member to form plural crest portions (3a) and trough portions (3b), are overlapped. Said flat filter members (2) and corrugated filter members (3) are set alternately.

As shown in Figure 3, for said corrugated filter members (3), on one side edge $S_L$, the corrugated filter members are folded to form folding portion (4) such that end portions (3e) of their crest portions (3a) are in close contact with adjacent flat filter members (2), respectively. By means of this folding portion (4), end portion (3e) of each crest portion (3a) is closed. On other side edge $S_R$, the corrugated filter members are folded to form folding portion (5) such that end portions (3e) of trough portions (3b) are in close contact with adjacent flat filter members (2), respectively. By means of this folding portion (5), end portion (3e) of each trough portion (3b) is closed. In this way, folding portion (4) and folding portion (5) are folded in directions opposite one another, and they are folded inward such that end surfaces (4e), (5e) of folding portions (4), (5) have a nearly semicircular shape. As shown in Figures 1 and 2, at said folding portions (4), (5), each corrugated filter member (3) and adjacent flat filter members (2), (2) are bonded to each other with adhesive (6) to form sealing portions (7). Said sealing portions (7) are formed by bonding end surfaces (4e), (5e) of folding portions (4), (5) of corrugated filter members (3) with opposite surfaces (2a) of flat filter members (2), respectively.

By laminating to form said filter element (1) as explained above, as shown in Figure 4, a plan view, the cross-section of the element becomes a honeycomb shape, with individual chambers (8).

In the following, operation of the filter element of this invention with the aforementioned constitution will be explained.

As shown in Figures 4 and 5, air as the fluid to be filtered flows into the element through plural inlets ($1_{IN}$) formed in a nearly triangular shape with said flat filter members (2) and corrugated filter members (3) [and flows as] indicated by arrow A in Figure 5(a). Air flows in flow channels (10) formed between flat filter members (2) and corrugated filter members (3),

and, as it passes through the filtering planes of flat filter members (2) and corrugated filter members (3), it is filtered. The filtered air then flows from outlets ($1_{OUT}$) (only passage through flat filter member (2) illustrated in this figure). Also, air as the fluid to be filtered that goes straight in flow channel (10) as indicated by arrow B, passes through folding portion (5) and is filtered.

Also, as another scenario, the fluid to be filtered does not flow through inlets ($1_{IN}$) into the element. Instead, as indicated by arrow C in Figure 5(b), it directly passes through folding portion (4) on the inlet side of the element and is filtered, it then flows into the element, flows straight in flow channel (10), and flows from outlets ($1_{OUT}$).

In this way, for the filter element of this invention, on one side edge of corrugated filter members (3), folding portion (4) is formed such that crest portions (3a) are in close contact with adjacent flat filter members (2), respectively, and, on the other side edge, folding portion (5) is formed such that trough portions (3b) adjacent to said crest portions (3a) are in close contact with the adjacent flat filter members, respectively. Consequently, said folding portions (4), (5) form filtering planes, leading to a decrease in air passage resistance and an increase in the filtering area. Also, by folding the folding depth of folding portions (4), (5) more deeply, the filtering area can be further increased. Also, as shown in Figure 4, filter element (3) [sic; (1)] has a honeycomb-like cross-sectional shape. Since such honeycomb-shaped cross-section is formed, the filtering member has individual chambers (8). Said individual chambers (8) have an advantage in that they can prevent dust attached on the surface of the filtering paper from movement under the influence of the fluid. If the dust moves, a cake layer of the dust cannot be formed, and the lifetime is shorter. Since this problem can be prevented, the lifetime increases.

In the explanation for the application examples, folding portions (4), (5) have a semicircular shape. However, another shape may also be adopted as long as close contact with adjacent flat filter members (2), (2) can be realized.

In the following, examples will be explained of a vortex-shaped element, an elliptic-shaped element and a laminated element formed by winding or laminating filter elements (1) of this invention shown in Figures 1 through 5.

Vortex-shaped element E shown in Figure 6 is prepared by laminating one flat filter member (2) and one corrugated filter member (3) having folding portions (4) and (5). Then, the laminate is wound in a vortex shape on the periphery of cylindrical axial center (12), with said corrugated filter member (3) on the inner side. At folding portions (4), (5), adhesive (6) is applied to bond corrugated filter member (3) with adjacent flat filter members (2), (2).

Elliptic-shaped element E shown in Figure 7 is prepared by laminating one flat filter member (2) and one corrugated filter member (3) having folding portions (4) and (5). Then, the laminate is wound in an elliptic shape on the periphery of elliptic-shaped axial center (13), with

said corrugated filter member (3) on the inner side. At folding portions (4), (5), adhesive (6) is applied to bond corrugated filter member (3) with adjacent flat filter members (2), (2).

Laminated element E shown in Figure 8 is prepared by laminating individual flat filter members (2) and individual corrugated filter members (3) having folding portions (4) and (5), alternately. Then, at folding portions (4), (5), adhesive (6) is applied to bond each corrugated filter member (3) with adjacent flat filter members (2), (2).

Experimental results

In the following, experimental results of the filter element of this invention as compared with those of conventional filter elements will be described.

A total of 8 types of dust samples defined in JISZ8901 were used in the test, which was performed according to the method defined in JISD1612. The flow rate of the air in the test is 6.5 /min [sic; L/min].

Figure 9 is a diagram illustrating filtering efficiency (%) versus feed dust quantity (g). In this figure, the abscissa represents the feed dust quantity (g), the ordinate represents the filtering efficiency (%), the broken line indicates the results of a conventional filter element, and the solid line indicates the results of a filter element of this invention. As can be seen from Figure 9, the filtering efficiency of the filter element of this invention is more than 1% higher than that of the conventional type.

Figure 10 is a diagram illustrating the air passage resistance (mmAq) versus air flow rate (L/min). In this figure, the abscissa represents the air flow rate (L/min), the ordinate represents the air passage resistance (mmAq), the broken line indicates the results of a conventional filter element, and the solid line indicates the results of a filter element of this invention. As can be seen from Figure 10, the air passage resistance of the filter element of this invention is significantly lower than that of the conventional type.

Effect of the invention

As explained above with reference to application examples, this invention provides a type of filter element which is composed of sheet-shaped flat filter members and corrugated filter members, each of which is prepared by folding a sheet-shaped filter member to form plural crest portions and trough portions, set alternately; on one side edge of said corrugated filter members, each corrugated filter member is folded such that its crest portions are in close contact with the adjacent flat filter member; by means of this folding portion, the end portion of each crest portion is closed; on the other side edge, each corrugated filter member is folded such that the trough portions are in close contact with the adjacent flat filter member; by means of this folding portion, the end portion of each trough portion is closed. Consequently, there is no need to use an

adhesive or other filling sealer to close the two end portions of said crest portions and trough portions. Instead, said two end portions can also be used as filtering planes. Consequently, the filter element of this invention has a large filtering area, so that the filtering efficiency can be improved. Also, since the dust that can be collected per unit area of the filtering element is constant, increase in the filtering area leads to a corresponding increase in the lifetime of the element.

Also, according to this invention, when the element is evaluated at the same flow rate, since the filtering area is larger, the flow velocity of the air passing through the element decreases, leading to increase in the filtering efficiency.

In addition, because the two end portions of the crest portions and trough portions of the element of this invention are not closed with filling sealant, it is possible to reduce the air passage resistance when the air as the fluid to be filtered flows into the element and flows out to the clean side.

Brief description of the figures

Figure 1 is an oblique view illustrating a filter element of this invention. Figure 2 is a cross-sectional view of the filter element. Figure 3 is an oblique view of the corrugated filter member of the filter element. Figure 4 is a plan view of the filter element. Figure 5 is a diagram illustrating operation of the filter element. Figures 6-8 are oblique views illustrating elements using the filter element of this invention. Figures 9 and 10 are diagrams illustrating the results of tests performed for comparing the filter element of this invention with a conventional type. Figure 11 is an oblique view illustrating a conventional filter element. Figure 12 is a diagram illustrating its operation.

1 Filter element
2 Flat filter member
3 Corrugated filter member
4 Folding portion
5 Folding portion
6 Adhesive
7 Sealing portion
8 Individual chamber
10 Flow channel

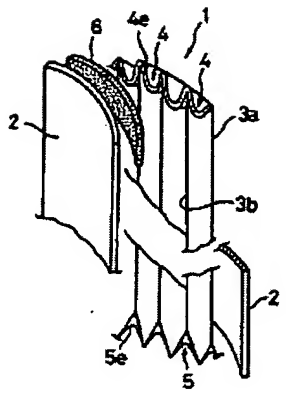


Figure 1

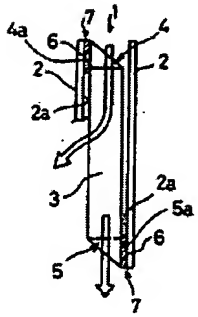


Figure 2

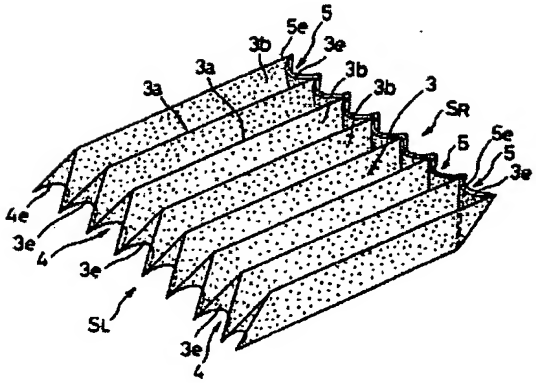


Figure 3

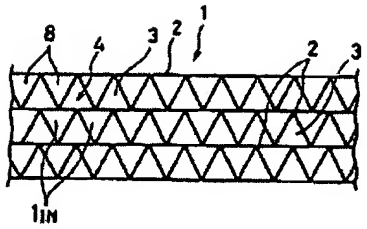


Figure 4

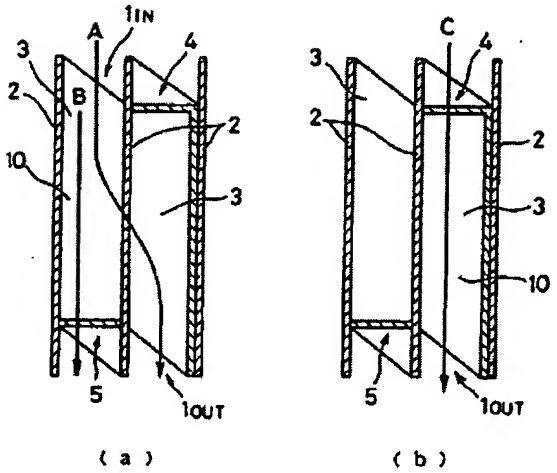


Figure 5

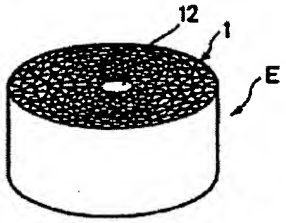


Figure 6

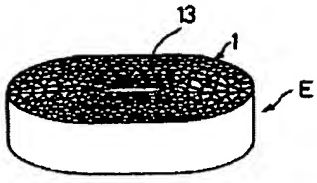


Figure 7

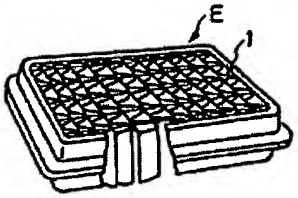


Figure 8

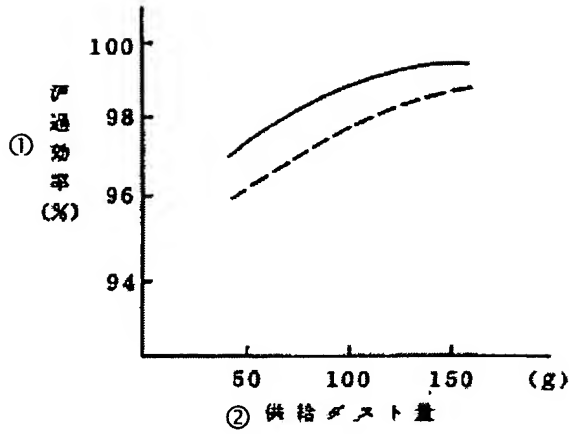


Figure 9

Key: 1 Filtering efficiency
2 Feed dust quantity

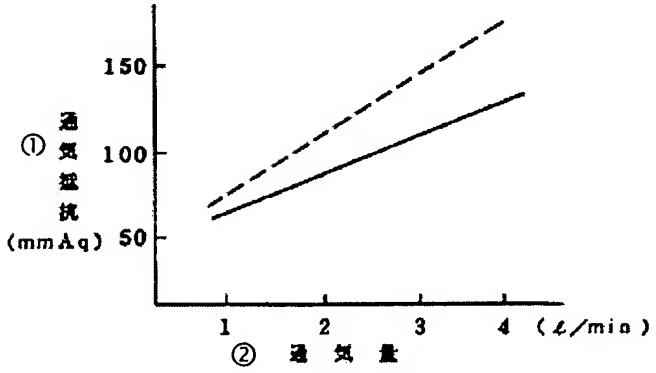


Figure 10

Key: 1 Air passage resistance
2 Air flow rate

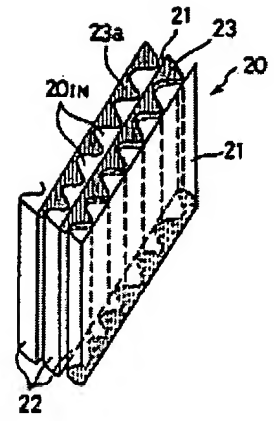


Figure 11

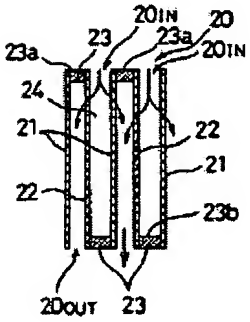


Figure 12